Response of the National Institute of Infectious Diseases, Sri Lanka to an unexpected dengue epidemic in 2017

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Introduction

The National Institute of Infectious Diseases (NIID), Sri Lanka previously known as the Infectious Diseases Hospital is the only designated quarantine hospital and the only specialized hospital for communicable diseases in Sri Lanka. This hospital was established more than 160 years ago during the British colonial period. It has 200 beds including one dedicated dengue ward which consists of 40 beds, which consists of male and female units. There are 4 consultant specialists, 45 medical officers, 75 nursing officers and 125 health assistants working in the hospital.

Dengue is a re-emerging mosquito-borne infectious disease which can cause a spectrum of clinical conditions ranging from "flu like illness" to life-threatening conditions [1]. Sri Lanka has been experiencing periodic epidemics in recent times. These have become progressively more severe, peaking during 2009-2014 period with 28,000 to more than 40,000 cases reported each year (44,461 cases reported in 2012) [2]. The biggest epidemic of dengue in Sri Lanka before 2017 was the epidemic in 2014 [3]. However, the 2017 epidemic was bigger than all these with more than 180,000 reported dengue [3]. The NIID as the leading hospital for managing dengue patients in Sri Lanka played a major role during the recent massive epidemic. This article describes the number and characteristics of dengue patients who were treated at the NIID during the epidemic and discusses the resources management in response to a public health emergency.

Methodology

A retrospective descriptive cross sectional study included all patients who were treated at the NIID during the epidemic. Data were extracted from out-patient department registers and bed head tickets. Population data and national statistics were taken from the National Dengue Control Unit. Dengue was diagnosed based on clinical signs, symptoms, and hematological tests according to Ministry of Health guidelines, which were adapted from the guidelines of the World Health Organization (WHO) 1997. In-depth interviews and focal group discussions were carried out to collect qualitative data.

Results

Quantitative data analysis

Figure1 shows the weekly report of dengue cases in the country from 2012-2017 and its relationship to monsoon rains. Compared to the past years, there was dramatic increase in the number of patients in June and July 2017 followed by a sharp acute decrease in August.

The out-patient department attendance to the NIID was higher from January to July 2017 compared to the previous year, although it fluctuated over the months. Compared to 2016 the total number of admissions increased nearly two folds from January 2017 and this trend continued up to July (Figure 2).

The average rate of bed occupancy did not exceed the total bed strength (<100%) of 200 during 2016, whereas the hospital was overloaded with patients, with bed occupancy > 100% during the entire period of January to July 2017 (Figure 3).

Full blood count (FBC) and packed cell volume (PCV) are main basic investigations used to assess and monitor the state of dengue fever. The number of tests of FBC and PCV in 2016 and 2017 correlated with the number of patients (Figure 4).

In NIID there were 37 deaths due to dengue. Ten deaths occurred during May, which is the highest for the year (Figure 5). Twenty deaths (over 50% of the deaths) occurred within 48 hours of admission (Figure 6). In-depth review of these deaths found that these deaths were

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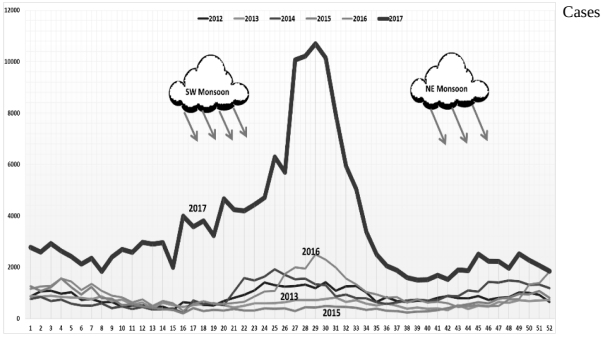
inevitable due to delayed transfer or delayed admission. This indicates that these patients were admitted to NIID during the critical state, which is not irreversible. As NIID had 200 beds it could manage the highest case load compared to other large hospitals while maintaining a CFR less than 0.2% (Figure 7) [3].



**National Dengue Control Unit, 2018*

Figure 1. **Number of total dengue cases/week reported from hospitals island wide from 2012 to 2017.**

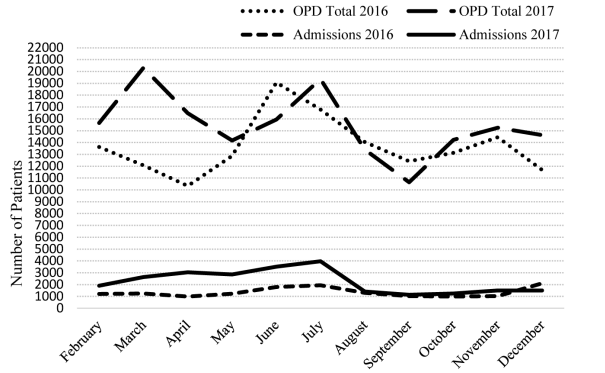


Figure 2. **Total number of patients who attended the OPD and total admissions to NIID in 2016 and 2017.**

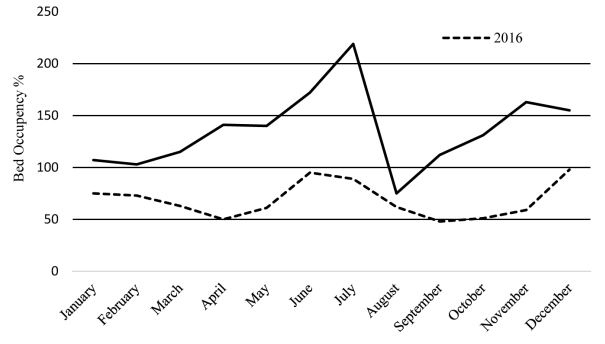


Figure 3. **Average bed occupancy rate of NIID in 2016 and 2017.**

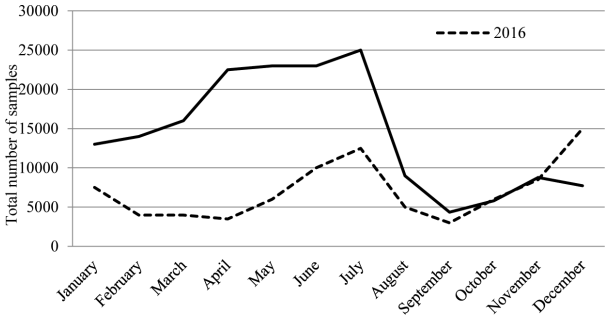


Figure 4. **Number of haematology lab tests done during 2016 and 2017 at NIID.**

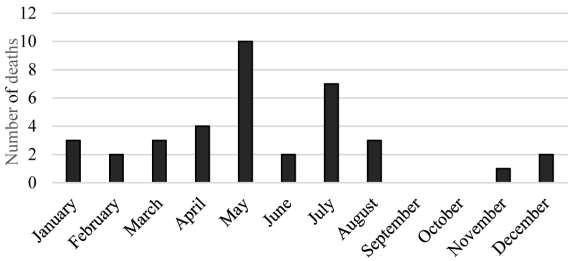


Figure 5. **Number of dengue deaths which occurred in NIID in 2017.**

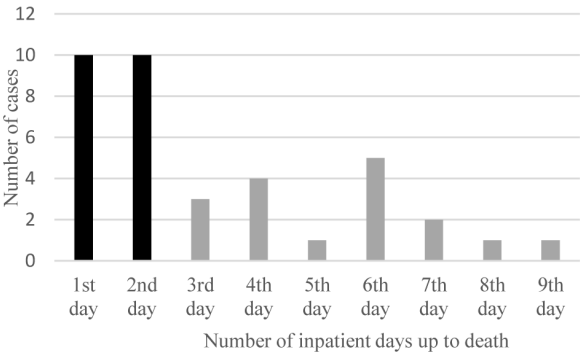
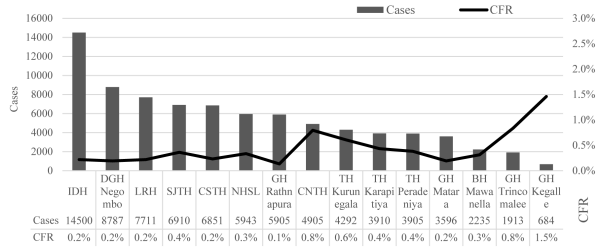


Figure 6. **Number of in-patient days from admission to death of dengue cases at NIID in 2017.**



**National Health Development Committee, Ministry of Health (2018)*

Figure 7. **Dengue deaths and case fatality ratios (CFR) in hospitals islandwide during the 2017 epidemic (up to August).**

Qualitative data analysis

As the figures indicate, a severe epidemic of dengue was experienced during the period April to August 2017. The midnight total of patients exceeded 100% bed occupancy resulting in increased hospital workload. More than 80% who presented to the OPD had fever and 99% were suspected of having dengue. This was the trend from 2016 December.

The success story of the NIID was maintaining a very low case fatality rate (<0.2%) while providing care for the largest case load compared to other large hospitals in the country [4].

In the initial stage of the epidemic, the first challenge was to provide accommodation for the large number of in-patients. Urgent procurement of hospital beds along with few essential ward equipment was carried out promptly by the Director. Some ward items were borrowed from nearby hospitals. Extra beds placed in all available spaces in the wards. Continuous supply of drugs, surgical and general consumable items had to be increased accordingly. Increasing the supply of Dextran 40, which is considered an essential drug in managing complications of dengue during hemorrhagic phase of dengue (DHF) was a major challenge [5]. There were many complaints by ward staff regarding inadequate human resources. We informed the Ministry of Health and assistance was sought from all nearby hospitals which were managed both centrally and provincially. Many hospitals readily agreed to send staff on temporary basis to NIID. All such staff from other hospitals were given a short orientation training on monitoring and management of dengue cases in order to maintain quality of care.

However, bed occupancy rates continued to increase and Ministry authorities were formally informed regarding severe ward congestion. The hospital had been over-burdened and some patients who should have been admitted could not be admitted. Immediate measures were taken to construct a prefabricated field ward in the hospital premises with the help of the Sri Lanka Army. Bed occupancy progressively increased exceeding 200% (Figure 3). In order to reduce the admissions and discharges of patients, the admission policy and discharge criteria were narrowed while ensuring that all critical and complicated cases were admitted to the hospital.

Establishing a "fever corner" at the OPD with a consultant physician made sure that all patients with fever were assessed by a consultant in the OPD. Patients who were in the initial stage of suspected dengue were treated as out-patients. They were given medication and relevant health education, while six hourly consultations were carried out at the fever corner.

All hospital wards were triaged and admissions were sent to wards according to the state of the dengue infection. Critical patients were treated in high dependency units (HDU) where patients were managed by experienced clinical teams, while other wards were managed by the rest of the staff. Duty rosters were arranged according to the work load and many duty shifts had to be arranged on overtime basis due to the shortage of staff.

All other supportive services were optimized. Laboratory service schedules of collecting and distributing investigation reports were revised to respond to the demand. All back up machines were utilized. Continuous procurement had to be carried out of reagents exceeding allocation. Providing adequate sanitary facilities was a big challenge during this period. An in-house maintenance team worked round the clock carrying out frequent repairs. New cluster toilets were built by engineering troops of the Sri Lanka Army. Extra troops from tri-forces were recruited to assist patients care services. Members of the Hospital Development Committee and many donors assisted in supplying many items including diet, linen and cleaning accessories.

As a result of continuous advocacy to higher authorities, the hospital was provided with extra clinical teams including consultant physicians, senior registrars, medical officers and nurses. By this time the entire country was alarmed and a public health emergency situation was communicated throughout the country. National level programs were initiated for prevention as well as to strengthen the hospitals as an acute measure to accommodate and treat dengue patients. As mass media alerted the public regarding certain preventable deaths due to dengue, the public became concerned about the quality of the hospital services.

Activities were undertaken to increase the morale of the staff to sustain their commitment and dedication. Long queues could be seen at every counter in the hospital. The hospital employees were taxed especially during the night shifts, as many admissions occurred during in the afternoon and overtime arrangements had to be made. Some staff had to work more than 24 hours continuously. Snacks were provided to them during work hours.

After a few dengue cases were detected among staff, prompt action was taken by the management to limit hospital transmission of dengue. Frequent residual fogging, supplying mosquito repellants and vaporizers to all staff and cleaning campaigns were carried out in the hospital.

Despite all these efforts the caseload continued to increase. Ultimately, NIID was affiliated with three peripheral hospitals, namely District Hospitals Thalangama, Piliyandala and Wethara. Clinical staff and other facilities were established in these hospitals by Ministry of Health. Extra ambulances were deployed for inter-hospital patient transport. A communication network was established which enabled continuous monitoring of supplies and to manage technical issues. Complicated patients were transferred to NIID for further management.

Meanwhile, drug reactions had been detected in few patients. Clinical audits revealed that it was specifically due to a brand of Dextran made in India. Prompt action was taken to inform National Drugs Quality Assurance Laboratory. Some in-patients were students who were due to sit for national examinations. The hospital management was able to get an examination center established in NIID premises by the Department of Examinations. Many religious and spiritual activities were arranged in wards to comfort patients and the staff. In some families all family members had dengue. They were unable to find by-standers, therefore ward staff provided extra support to these patients.

By this stage, the whole country was alarmed and the Ministry of Health made arrangements to open dedicated dengue units. Increasing bed availability in other hospitals provided a slight relief to the congestion at NIID. Due to intensive public involvement and favourable environmental change the dengue epidemic was successfully controlled by the end of August 2017.

Discussion

Demographic and social changes which occur due to population growth, urbanization and modern transportation have contributed greatly to increased incidence of dengue cases [6]. Major epidemics had been reported in many tropical developing countries [7].

The largest dengue hyper-endemic situation was experienced in Sri Lanka during the year 2017. Many dengue patients from all over the country sought treatment at the NIID compared to other hospitals. The 'good name' of the hospital or the 'word of mouth' of patients who had been treated well at NIID, induced people from all over the country to seek treatment for dengue from NIID [8].

The maximum bed occupancy rate for a hospital to provide optimum patient care is 60%, because patient care involves technical, administrative and supportive services parallel to clinical care [9]. The biggest challenge that the hospital faced during this epidemic was to accommodate and manage a large number of patients, since there are only 200 beds available at NIID. The need to identify surge capacities in health facilities during planning has been highlighted [10]. Surge capacity defines the space, staffing and supplies during a mass casualty incident to aid rapid response [11]. These should be included in disaster management plans in all health institutions. Health administrators have been urged to undertake evidence based planning decisions to respond specifically to dengue epidemics [12]. The ability and willingness to report to duty by health care workers during different catastrophic disaster events had been researched in depth and it had been shown that most factors are amenable to resolution within institutions [13].

Conclusions and recommendations

A massive epidemic of dengue was experienced in 2017. The NIID was able to manage a record number of in-patients (>17,000) with a bed strength of only 200, whilst maintaining a minimum case fatality rate. It was achieved by making prompt internal arrangements to increase surge capacity in the hospital and the excellent team performance of NIID staff with positive leadership.

Public health emergencies which need mass critical care could happen at any time. Due to the absence of pre-identified resources for surge capacity at NIID, hospital had to strive to respond and sustain sufficient services to patients. Therefore, health systems must be prepared to implement surge strategies in hospitals with comprehensive emergency response plans, which should be built based on current knowledge, experience, and expert opinion. Pre-identified documented resources to improve surge capacity should be included in the emergency response plan of a hospital.

Conflicts of Interest

Authors declare that there are no conflicts of interest.

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